

1. A method of eliminating volcano effect in dual damascene comprising the steps of:

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providing a substrate having first and second insulative layers, optionally separated from each other by an intervening etch-stop layer formed thereon said substrate;

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forming a hole opening through said first and second insulative layers;

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forming a fill material over said substrate, including in said hole opening;

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removing any excess fill material over said hole opening;

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forming a trench opening in said second insulative layer over said hole opening in said first insulative layer, thus completing the forming of said dual damascene structure on said substrate;

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removing said fill material from said hole opening;

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depositing metal in said dual damascene structure; and

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removing excess metal to complete the forming of said dual damascene without the volcano effect.

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2. The method of claim 1, wherein said substrate is silicon.

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3. The method of claim 1, wherein said first insulative layer is a low-k dielectric having a dielectric constant between about 2.2 to 3.5.

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4. The method of claim 1, wherein said first insulative layer has a thickness between about 1000 to 10000 Å.

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5. The method of claim 1, wherein said optional intervening etch-stop layer is silicon nitride.

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6. The method of claim 1, wherein said second insulative layer is a low-k dielectric having a dielectric constant between about 2.5 to 3.5.

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7. The method of claim 1, wherein said second insulative layer has a thickness between about 1000 to 10000 Å.

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8. The method of claim 1, wherein said fill material comprises I-LINE PR.

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9. The method of claim 1, wherein said fill material comprises spin-on organic oxide such as SiLK or FLARE.

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10. The method of claim 1, wherein said removing said excess fill material is accomplished by chemical mechanical polishing (CMP), or by etching.

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11. The method of claim 1, wherein said metal comprises copper.

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12. The method of claim 1, wherein said metal has a thickness between about 1000 to 15000 Å.

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13. The method of claim 1, wherein said removing said excess metal is accomplished by chemical mechanical polishing (CMP).

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14. A method of eliminating volcano effect in dual damascene comprising the steps of:

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providing a substrate having a passivation layer formed over a first metal layer formed on said substrate;

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forming a first insulative layer over said substrate;

9 forming an optional etch-stop layer over said first insulative layer;

12 forming a second insulative layer over said etch-stop layer;

15 forming a first photoresist layer over said second insulative layer and patterning said photoresist to form a first photoresist mask having a hole pattern;

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etching said first and second insulative layers, including said optional etch-stop layer through said hole pattern to form a hole reaching said passivation layer;

removing said first photoresist mask;

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forming a fill material over said substrate, including in said hole opening;

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removing any excess fill material over said hole opening;

30 forming a second photoresist layer over said substrate,  
including said hole opening and patterning said second  
photoresist to form a second photoresist mask having a  
33 trench pattern;

etching said second insulative layer through said trench  
36 pattern in said second photoresist mask to form a trench in  
said second insulative layer, thus completing the forming  
of said dual damascene structure in said substrate ;

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removing said second photoresist mask;

42 removing said fill material from said hole opening;

depositing a second metal in said dual damascene structure;

45 and

removing excess metal to complete the forming of said dual  
48 damascene without the volcano effect.

**15.** The method of claim 14, wherein said substrate is silicon.

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**16.** The method of claim 14, wherein said first metal is copper.

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**17.** The method of claim 14, wherein said first insulative layer is a low-k dielectric having a dielectric constant between about 2.2 to 3.5.

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**18.** The method of claim 14, wherein said first insulative layer has a thickness between about 1000 to 10000 Å.

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**19.** The method of claim 14, wherein said optional etch-stop layer is silicon nitride.

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**20.** The method of claim 14, wherein said second insulative layer is a low-k dielectric having a dielectric constant between about 2.2 to 3.5.

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**21.** The method of claim 14, wherein said second insulative layer has a thickness between about 1000 to 10000 Å.

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**22.** The method of claim 14, wherein said fill material comprises i-line PR.

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**23.** The method of claim 1, wherein said fill material is spin-on organic oxide, such as SiLK or FLARE.

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**24.** The method of claim 14, wherein said removing said excess fill material is accomplished by chemical mechanical polishing (CMP).

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**25.** The method of claim 14, wherein said second metal comprises copper.

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**26.** The method of claim 14, wherein said second metal has a thickness between about 1000 to 15000 Å.

**27.** The method of claim 14, wherein said removing said excess metal is accomplished by chemical mechanical polishing (CMP).